DSN Research and Technology Support

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The activities of the Development Support Group in operating the Venus Deep Space Station (DSS 13) and the Microwave Test Facility (MTF) for the period December 16, 1972 through February 15, 1973 are presented, categorized by facility and section supported. Major activities include continuation of the intensive dual-carrier investigation, refurbishing of the S-band megawatt transmit (SMT) cassegrain feedcone, implementation of the dedicated antenna pointing computer for the 26-m antenna, and continuation of collection of Faraday rotation data. A description of the dual-carrier test program and results to date are given, together with details of other activities during the period.

During the two months ending February 15, 1973, the Development Support Group was primarily engaged in the following activities at DSS 13 and the Microwave Test Facility (MTF) at the Goldstone Deep Space Communications Complex.

I. DSS 13 Activities

A. In Support of Section 331

Planetary radar. Continuing support of the Mariner Venus/Mercury 1973 spacecraft mission, ranging measurements to the planet Venus were made. These measurements are made using the 64-m-diam antenna and 400-kW transmitter at DSS 14 for transmission and reception, with pseudonoise code generation, data processing, and control being performed at DSS 13. Ranging measurements with a resolution of five microseconds were made of Venus for a total of seven good signal runs during this period. The range to Venus has steadily increased and was 247×10^6 km on February 15, 1973.

B. In Support of Section 333

Faraday rotation data collection. Utilizing both a dual-channel phase-lock receiver and a non-phase-lock receiver with a rotating antenna, Faraday rotation data continue to be collected on a 24-hour per day basis, with the data being punched onto paper tape and printed on a teleprinter by the data system at DSS 13. These data, when mapped (in both frequency and direction) to the spacecraft look angle, are used to correct measured range and doppler data.

C. In Support of Section 335

1. 26-m antenna pointing computer. After adding core memory and refurbishing, a surplus SDS 910 computer (obtained from NASA) was interfaced with the prototype antenna pointing system rack and implemented to control the pointing of the 26-m antenna. Unlike the other computers at DSS 13, which are also used for tape generation, computation, etc., this computer has no assigned tasks other than moving and controlling the pointing of the 26-m antenna. With this dedicated computer and modification of the antenna drive computer program, the requirement for a skilled servo operator is lessened since the computer can assure that harmful acceleration rates are not applied to the antenna.

2. Dual uplink carrier testing. Evaluation has continued of the intermodulation products (IMP) present in the downlink as a result of dual uplink carriers being transmitted by a single transmitter klystron. After completing an intensive program of antenna "clean-up" (Ref. 1), intermodulation product levels had stabilized at the -165 to -170-dBm level, and further testing was scheduled to gain experience on effects of longer term operation. During the period December 16, 1972 through February 5, 1973, 336 hours of testing have been performed on this project. After approximately a month of fairly regular operation, the intermodulation product level gradually worsened toward the -150-dBm level. A review of the past days' operating logs revealed nothing significant, so disassembly of the waveguide system was commenced, with testing proceeding on smaller and smaller systems as pieces were removed. Upon removal of the diplexer, system noise decreased. Examination of the diplexer revealed that the plating around the tuning posts had cracked. The diplexer is electroformed of nickel over copper; the posts are of wrought copper and are "grown in" (plated into place) during the electroforming. It is felt that thermal cycling and differential expansion or improper bonding during manufacture caused the plating to crack, thus allowing arcing to take place in this area of high field strength. The diplexer has been carefully cleaned and these posts have been soft soldered into place. Testing will be resumed with all waveguide system parts recleaned and reassembled. The object of further testing is to gather data on long-term intermodulation performance under routine maintenance of the system.

The maser originally used for these tests was a standard DSN Block II which had performed perfectly since initial successful cooldown. However, during the week ending December 24, 1972, this maser refrigerator warmed up three times, apparently due to contamination being introduced into the system. The refrigerator and maser were replaced with a pseudo-Block III system to attain additional maser gain, greater gain stability, and faster cooldown. However, this replacement did not solve the warm-up problems as there were three warm-ups the following week, the last of which resulted in a burned out crosshead drive motor. Extensive purging of the system, accompanied by a change of the compressor, followed by simultaneous vacuum pumping of the entire system was successful in eliminating the contamination problem, and the system was successfully cooled down in mid-January and has remained cold since that time.

II. Microwave Test Facility Activities

A. In Support of Section 333

Refurbishment of SMT cassegrain feedcone for DSS 14. Upon removal of the SMT cassegrain feedcone from DSS 14, the waveguide components were removed at the MTF while the cone shell and feedhorn were shipped to a vendor for installation of the reflector to be used with the multiple-frequency X- and K-band (MXK) feedcone. The waveguide system components were carefully cleaned, lapped, and sent to a vendor for a finishing process (iriditing) which provides a smooth surface resistant to oxidation. Upon receipt of the SMT feedcone with the reflector installed, the waveguide system was reinstalled and dual carrier testing accomplished at the dual 7-kW carrier level (the maximum which could be generated in that configuration). Good intermodulation performance was observed and the cone was reinstalled onto the DSS 14 64-m antenna. However, after reinstallation, dual 40-kW carrier testing was accomplished at DSS 14, and poor intermodulation performance was observed. At this time it is not certain whether the poor performance is due to the effects of the 64-m antenna, the higher power available for testing, or another manifestation of the diplexer problem discussed earlier in this article.

B. In Support of Section 335

1. Non-interruptable waveguide pressurization manifold. Working from plans and parts supplied by Section 333, a waveguide pressurization manifold designed to be supplied from two liquid-nitrogen dewars was fabricated for use at DSS 13 on the 26-m antenna. Continuous pressurization of the waveguide is important in maintenance of good intermodulation product performance.

2. Dual carrier. The majority of the available manpower continued to support dual-carrier testing at DSS 13. Disassembly and cleaning of waveguide components, including switches, reinstallation of cleaned components, and fabrication of special bracketry and mounts, are typical of the support given this project during this period.

Reference

1. Jackson, E. B., and Price, A. L., "Development Support Group," in *The Deep Space Network Progress Report*, Technical Report 32-1526, Vol. XIII, pp. 127–129. Jet Propulsion Laboratory, Pasadena, Calif., Feb. 15, 1973.